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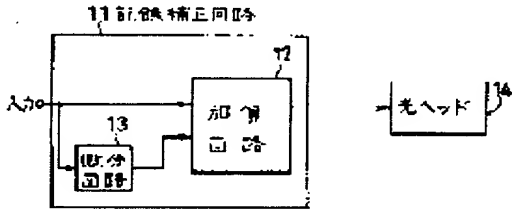
(54) RECORDING CORRECTION CIRCUIT

(57)Abstract:
PURPOSE: To perform stable optical recording without changing a recording waveform in each input pattern in optical recording and without being influenced by a heat conductivity of a recording medium and front and rear recording marks.
CONSTITUTION: An input signal is inputted to a differentiation circuit 13 to obtain a differential signal corresponding to the quantity of a change of the input signal. This differential signal and the original input signal are inputted to an addition circuit 12 to be added up, and an optical head 14 is driven by this output signal. By this method, recording is performed by correcting the heat conductivity of the recording medium, and the stable optical recording without being influenced by the front and rear recording marks is performed, thus eliminating the need of changing the recording waveform in each input pattern.



LEGAL STATUS

[Date of request for examination]

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[Date of final disposal for application]

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[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The record amendment circuit characterized by having the 2nd circuit which adds as an input the 1st circuit which considers an input signal as an input and calculates the variation of this input signal in the record amendment circuit of the optical storage which records information using an optical head, and said input signal and output of said 1st circuit.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] About the record circuit in optical recording, such as an optical disk, in order to make it this invention not influenced by the heat-conduction property of a medium in detail, it relates to the record amendment circuit which amends a record wave.
[0002]
[Description of the Prior Art] In optical recording, such as an optical disk, in order to be influenced by the heat-conduction property of a medium, to distort a record mark or to carry out, amendment of a record wave is performed. As this kind of a technique, there are the record approach indicated by JP,3-185628,A and an example of equipment. The configuration of the conventional example is shown in drawing 6 . the inside of drawing, and 61 -- a signal generator and 68 -- MP (multi-pattern) circuit and 62 -- the modulator of the MP circuit 68, and 63 -- in an optical head and 66, a spindle motor and 67 express an optical disk and, as for the pattern generator of the MP circuit 68, and 64, 69 expresses [a switch and 65] the reference voltage setting circuit.
[0003] First, if record is directed by the record gate signal Wg, in the reference voltage setting circuit 69, the current Ia for record and a bias current Ib will be generated. Here, if the record signal S1 and a clock C1 (signalling frequency of the integral multiple of the clock of the record signal S1) are inputted from a signal generator 61, the modulator 62 and the pattern generator 63 in the MP circuit 68 will operate, an exchange of the input pattern signal S2 and the record pattern signal S3 will be performed by the meantime, and serial signal S4 for record of a suitable pattern will be generated for every input pattern of the record signal S1. A switch 64 operates by serial signal S4 for this record, and the current Ia for record is adjusted. This current Ia for record is superimposed by the bias current Ib, the optical head 65 drives with these currents, a light beam occurs from the optical head 65, and record is performed on an optical disk 67. In addition, Ir in drawing is a current for read-out which is generated in the reference voltage setting circuit 69 at the time of read-out, and drives the optical head 65, when the record gate signal Wg is lost.
[0004]
[Problem(s) to be Solved by the Invention] However, by the record approach by the above-mentioned conventional example, the record wave needed to be changed for every input pattern, and the signal pattern corresponding to an input pattern needed to be recorded. Moreover, in the optical disk rotated by CAV (constant angular velocity) and MCAV, since a rate differs from record power on inner circumference and a periphery, it is necessary to record the signal pattern corresponding to an input pattern for every radius location of each optical disk. Therefore, many record patterns corresponding to an input pattern needed to be prepared for the pattern generator 63.
[0005] moreover, in a modulator 62 and the pattern generator 63, in order to perform an exchange of an input pattern and a record pattern, it obtained, when high-speed signal processing was not completed, and there was a problem.
[0006] This invention is made in order to solve the above-mentioned trouble, and the purpose is in offering the record amendment circuit which can perform stable optical recording which is not influenced of the heat-conduction property of a medium, or a record mark [before and after] without using the record pattern corresponding to an input pattern in optical recording.
[0007]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, in this invention, it is considering as the configuration which has the 2nd circuit which adds as an input the 1st circuit which

considers an input signal as an input and calculates the variation of this input signal, and said input signal and output of said 1st circuit in the record amendment circuit of the optical storage which records information using an optical head.

[0008]

[Function] In the record amendment circuit of this invention, by adding the variation of input signals, such as a signal which differentiated the input signal based on the input signal, to the original input signal, and considering as the output signal over an optical head, record which amended the heat-conduction property of a record medium was performed, stable optical recording which is not influenced of a record mark [before and after] was performed, and the need of changing a record wave for every input pattern is abolished.

[0009]

[Example] Hereafter, an example explains this invention to a detail.

[0010] First, the model of the record process of an optical disk explains the principle of this invention. A medium consists of the recording layer which consists of several layers and an up-and-down protective layer, and a substrate. Suppose that P (t) and the record beam spot are moving the optical reinforcement of the record beam spot in the x directions at a rate v. If it does in this way, the maximum temperature Tmax on a medium (s) can be approximated by the degree type.

[0011] Tmax(s)=P(s)G(s)

Here, P (s) is the Laplace-transform function of optical on-the-strength [of the record beam spot] P (t), and G (s) is the transfer function of the record process of an optical disk. G (t) which is the time-axis function of transfer function G (s) is given as follows.

[0012]

[Equation 1]

$$G(t)=\frac{1}{C_1\delta_1+C_0h+C_2\delta_2}\cdot\frac{\exp\left[-\frac{v\,t^2}{A_0^2+4\tau'}\right]}{\pi(A_0^2+4\tau')}$$

[0013] It is here and is [0014].

[Equation 2]

$$\delta_1=\sqrt{\pi D_1(t+t_c)},\quad \delta_2=\sqrt{\pi D_2(t+t_c)},$$

$$\tau'=\int_0^t D(t')\,t'=D_{eff}t,$$

[0015] tc is a constant. Moreover, D(t) =(lambda1delta1+lambda0 h+lambda 2delta2)/(C1delta1+C0 h+C 2delta2)

It comes out, and it is and they are lambda1=C1D1, lambda0=C0D0, and lambda2=C2D2.

[0016] If an approximation calculation is performed based on the above-mentioned function, transfer function G (s) will be drawn as follows.

[0017]

G(s)=b/(s+a) (2)

It is here and is [0018].

[Equation 3]

$$a=\frac{1}{2}\frac{(C_1\sqrt{\pi D_1}+C_2\sqrt{\pi D_2})^2}{(C_0h)^2}+\frac{4D_0}{A_\sigma^2}+\frac{v^2}{4D_\sigma},\quad b=\frac{1}{C_0h\pi A_0^2},$$

$$A_\sigma^2=A_0^2+4D_{eff}t_0,$$

$$D_\sigma=\frac{A_0^2}{4t_0}+D_{eff}$$

[0019] It becomes. however, the heat capacity of a recording layer, a substrate, and a protective layer -- the radius of Deff and the record beam spot is expressed with A0, and property time amount is expressed [C0 C1, C2, and a diffusion coefficient / the thickness of D0, D1 D2, and a recording layer] with t0 for the effective diffusion coefficient of h and the field inboard of a medium.

[0020] Therefore, what is necessary is just to perform amendment expressed with transfer function G(s)-1 of a degree type to an input side, in order to make medium temperature steep [in the mark edge section] to homogeneity in the record mark formation section, since a record process is expressed using transfer function [of a formula (2)] G (s).
[0021]
G(s)-1=(s+a)/b (3)
Here, when a differential constant is set to alpha and the constant of a differential circuit output is set to beta, the above-mentioned formula (3) can be expressed as follows.
[0022]
G(s)-1** beta-s / (second+alpha) +1 (4)
That is, as shown in the following examples, by adding to an input signal what differentiated the input signal in record identification, the temperature distribution on a medium will be homogenized and a good record mark can be formed.
[0023] Hereafter, the example of this invention is explained to a detail using a drawing.
[0024] The [1st example] Drawing 1 is the block diagram showing the 1st example of this invention. Among drawing, in a record amendment circuit and 12, the adder circuit in the record amendment circuit 11 and 13 express the differential circuit in the record amendment circuit 11, and 14 expresses [11] an optical head. An input is connected to one input side of an adder circuit 12, and the input side of a differential circuit 13, the output of a differential circuit 13 is connected to another input side of an adder circuit 12, and the output of an adder circuit 12 is made into the output signal to the optical head 14.
[0025] Hereafter, actuation and an operation of the example of the above-mentioned configuration are explained using the wave form chart of drawing 2 .
[0026] First, if the input signal shown in the input of the record amendment circuit 11 of drawing 1 by (1) of drawing 2 R> 2 enters, the differential signal of an input signal will be acquired in the differential circuit 13 which is an example which calculates the variation of an input signal. In addition, in a differential circuit 13, by lengthening the signal which delayed the input signal from an input signal shows the example which acquires a differential signal to (2) of drawing 2 here.
[0027] If it does in this way, differential circuit 13 output shown by (2) of the input signal shown in the adder circuit 12 by (1) of drawing 2 and drawing 2 will be inputted. An adder circuit 12 attaches and adds weight to these two signals at each, and drives the optical head 14 with that added output signal. Consequently, the optical output shown in (3) of drawing 2 is obtained from the optical head 14. If it records on a medium by such optical output, the heat-conduction property of a medium can be amended, a mark can be recorded as shown in the above-mentioned principle, and a stable record mark can be formed on a medium. Moreover, since it is not influenced of a record mark [before and after] and it is made when recording a mark on a medium, it is not necessary to change a record wave for every record pattern. In addition, it is also effective in the input of an adder circuit 12 to put in the delay circuit with which the phase contrast of an input signal and differential circuit 13 output is doubled.
[0028] Although the above-mentioned example showed the example which differentiates by delay differential, it cannot be overemphasized that the differential circuit which combined the usual resistance and capacity, the differential circuit which combined an inductance and capacity are sufficient as a differential circuit.
[0029] Moreover, it is not necessary to record a record pattern too many like before that what is necessary is just to amend according to the formula (3) or formula (4) mentioned above when rates differed in the inner circumference of an optical disk, and a periphery.
[0030] In addition, weighting of the input signal and differential circuit 13 output in an adder circuit 12 is good in the weighting multiplier of differential circuit 13 output also as below 10/a more than zero, when an input signal is set to 1. In this case, a good example makes the weighting multiplier of differential circuit 13 output below 2/a more than 0.5/a.
[0031] The [2nd example] Drawing 3 is the block diagram showing the 2nd example of this invention. To performing record amendment in front of the adder circuit whose 1st example is a head drive circuit, by this example, the impedance-conversion circuit 32 was formed in the head drive circuit 31 and the middle of the optical head 33, and it has realized. This example uses the property which the input impedance of the optical head 33 can approximate by resistance. Fundamental actuation of this example is the same as that of the 1st example.
[0032] A concrete example of the impedance-conversion circuit 32 is shown in drawing 4 . Moreover, the modification which added the standup amendment circuit of a current is shown in drawing 5 . As for C1 and C2, a capacitor, and R1, R2 and R3 are resistance among drawing. In these examples of a circuit,

resistance R1 and R2 was connected to the optical head 33 of drawing 3 at the serial, among these the capacitor C1 is connected to one resistance R1 at juxtaposition. Although the signal current at the time of a stationary flows through resistance R1 and R2, at the time of change of the signal from the head drive circuit 31, the differential current which is equivalent to a capacitor C1 and variation from the differential circuit of resistance R2 is added by resistance R2, and it flows at it. Moreover, in addition to the above-mentioned circuit, in the circuit of drawing 5 , the series circuit of a capacitor C2 and resistance R3 is connected to juxtaposition as a standup amendment circuit of a current at the output of the head drive circuit 31 of drawing 3 . This capacitor C2 and the circuit of resistance R2 have amended the standup of a drive current according to an integral operation.

[0033] In addition, since it becomes curve-like, it performs a pulse train, and even if [whose wave by the 2nd above-mentioned example is / like (3) of drawing 2 for the form of the rim section of the amplitude], it is good.

[0034]

[Effect of the Invention] If it records on a medium by the optical output by the record amendment circuit of this invention by the above explanation so that clearly, on a medium, the heat-conduction property of a medium can be amended, a mark can be recorded, and a stable record mark can be formed. Moreover, since it stops influencing of a record mark [before and after] when recording a mark on a medium, it is not necessary to change a record wave for every input pattern. Furthermore, when rates differ in inner circumference and a periphery like an optical disk, it is not necessary to memorize a record pattern according to a circumferential location. Moreover, since an input pattern does not need to perform deformation of a record wave with reference to a record pattern, high-speed record is realizable.

[Translation done.]

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TECHNICAL FIELD

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PRIOR ART

[Description of the Prior Art] In optical recording, such as an optical disk, in order to be influenced by the heat-conduction property of a medium, to distort a record mark or to carry out, amendment of a record wave is performed. As this kind of a technique, there are the record approach indicated by JP,3-185628,A and an example of equipment. The configuration of the conventional example is shown in drawing 6 . the inside of drawing, and 61 -- a signal generator and 68 -- MP (multi-pattern) circuit and 62 -- the modulator of the MP circuit 68, and 63 -- in an optical head and 66, a spindle motor and 67 express an optical disk and, as for the pattern generator of the MP circuit 68, and 64, 69 expresses [a switch and 65] the reference voltage setting circuit.
[0003] First, if record is directed by the record gate signal Wg, in the reference voltage setting circuit 69, the current Ia for record and a bias current Ib will be generated. Here, if the record signal S1 and a clock C1 (signalling frequency of the integral multiple of the clock of the record signal S1) are inputted from a signal generator 61, the modulator 62 and the pattern generator 63 in the MP circuit 68 will operate, an exchange of the input pattern signal S2 and the record pattern signal S3 will be performed by the meantime, and serial signal S4 for record of a suitable pattern will be generated for every input pattern of the record signal S1. A switch 64 operates by serial signal S4 for this record, and the current Ia for record is adjusted. This current Ia for record is superimposed by the bias current Ib, the optical head 65 drives with these currents, a light beam occurs from the optical head 65, and record is performed on an optical disk 67. In addition, Ir in drawing is a current for read-out which is generated in the reference voltage setting circuit 69 at the time of read-out, and drives the optical head 65, when the record gate signal Wg is lost.

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EFFECT OF THE INVENTION

[Effect of the Invention] If it records on a medium by the optical output by the record amendment circuit of this invention by the above explanation so that clearly, on a medium, the heat-conduction property of a medium can be amended, a mark can be recorded, and a stable record mark can be formed. Moreover, since it stops influencing of a record mark [before and after] when recording a mark on a medium, it is not necessary to change a record wave for every input pattern. Furthermore, when rates differ in inner circumference and a periphery like an optical disk, it is not necessary to memorize a record pattern according to a circumferential location. Moreover, since an input pattern does not need to perform deformation of a record wave with reference to a record pattern, high-speed record is realizable.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, by the record approach by the above-mentioned conventional example, the record wave needed to be changed for every input pattern, and the signal pattern corresponding to an input pattern needed to be recorded. Moreover, in the optical disk rotated by CAV (constant angular velocity) and MCAV, since a rate differs from record power on inner circumference and a periphery, it is necessary to record the signal pattern corresponding to an input pattern for every radius location of each optical disk. Therefore, many record patterns corresponding to an input pattern needed to be prepared for the pattern generator 63.
[0005] moreover, in a modulator 62 and the pattern generator 63, in order to perform an exchange of an input pattern and a record pattern, it obtained, when high-speed signal processing was not completed, and there was a problem.
[0006] This invention is made in order to solve the above-mentioned trouble, and the purpose is in offering the record amendment circuit which can perform stable optical recording which is not influenced of the heat-conduction property of a medium, or a record mark [before and after] without using the record pattern corresponding to an input pattern in optical recording.

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, in this invention, it is considering as the configuration which has the 2nd circuit which adds as an input the 1st circuit which considers an input signal as an input and calculates the variation of this input signal, and said input signal and output of said 1st circuit in the record amendment circuit of the optical storage which records information using an optical head.

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OPERATION

[Function] In the record amendment circuit of this invention, by adding the variation of input signals, such as a signal which differentiated the input signal based on the input signal, to the original input signal, and considering as the output signal over an optical head, record which amended the heat-conduction property of a record medium was performed, stable optical recording which is not influenced of a record mark [before and after] was performed, and the need of changing a record wave for every input pattern is abolished.

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EXAMPLE

[Example] Hereafter, an example explains this invention to a detail.
[0010] First, the model of the record process of an optical disk explains the principle of this invention. A medium consists of the recording layer which consists of several layers and an up-and-down protective layer, and a substrate. Suppose that P (t) and the record beam spot are moving the optical reinforcement of the record beam spot in the x directions at a rate v. If it does in this way, the maximum temperature Tmax on a medium (s) can be approximated by the degree type.
[0011] Tmax(s)=P(s)G(s)
Here, P (s) is the Laplace-transform function of optical on-the-strength [of the record beam spot] P (t), and G (s) is the transfer function of the record process of an optical disk. G (t) which is the time-axis function of transfer function G (s) is given as follows.
[0012]
[Equation 1]

$$G(t)=\frac{1}{C_1\delta_1+C_0h+C_2\delta_2}\cdot\frac{\exp\left[-\frac{v\,t^2}{A_0^2+4\tau'}\right]}{\pi(A_0^2+4\tau')}$$

[0013] It is here and is [0014].
[Equation 2]

$$\delta_1=\sqrt{\pi D_1(t+t_c)},\quad \delta_2=\sqrt{\pi D_2(t+t_c)},$$

$$\tau'=\int_0^t D(t')\,t'=D_{eff}t,$$

[0015] tc is a constant. Moreover, D(t) =(lambda1delta1+lambda0 h+lambda 2delta2)/(C1delta1+C0 h+C 2delta2)
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[0016] If an approximation calculation is performed based on the above-mentioned function, transfer function G (s) will be drawn as follows.
[0017]
G(s)=b/(s+a) (2)
It is here and is [0018].
[Equation 3]

$$a=\frac{1}{2}\frac{(C_1\sqrt{\pi D_1}+C_2\sqrt{\pi D_2})^2}{(C_0h)^2}+\frac{4D_0}{A_\sigma^2}+\frac{v^2}{4D_\sigma},\quad b=\frac{1}{C_0h\pi A_0^2},$$

$$A_\sigma^2=A_0^2+4D_{eff}t_0,$$

$$D_\sigma=\frac{A_0^2}{4t_0}+D_{eff}$$

[0019] It becomes. however, the heat capacity of a recording layer, a substrate, and a protective layer -- the radius of Deff and the record beam spot is expressed with A0, and property time amount is expressed

[C0 C1, C2, and a diffusion coefficient / the thickness of D0, D1 D2, and a recording layer] with t0 for the effective diffusion coefficient of h and the field inboard of a medium.
[0020] Therefore, what is necessary is just to perform amendment expressed with transfer function G(s)-1 of a degree type to an input side, in order to make medium temperature steep [in the mark edge section] to homogeneity in the record mark formation section, since a record process is expressed using transfer function [of a formula (2)] G (s).
[0021]
G(s)-1=(s+a)/b (3)
Here, when a differential constant is set to alpha and the constant of a differential circuit output is set to beta, the above-mentioned formula (3) can be expressed as follows.
[0022]
G(s)-1** beta-s / (second+alpha) +1 (4)
That is, as shown in the following examples,. by adding to an input signal what differentiated the input signal in record identification, the temperature distribution on a medium will be homogenized and a good record mark can be formed.
[0023] Hereafter, the example of this invention is explained to a detail using a drawing.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the 1st example of this invention
[Drawing 2] The wave form chart explaining actuation of the 1st example of the above
[Drawing 3] The block diagram showing the 2nd example of this invention
[Drawing 4] The circuit diagram showing the example of the impedance-conversion circuit of the 2nd example of the above
[Drawing 5] The circuit diagram showing the modification of the example of the impedance-conversion circuit of the 2nd example of the above similarly
[Drawing 6] The block diagram explaining the conventional example
[Description of Notations]
11 -- Record amendment circuit
12 -- Adder circuit
13 -- Differential circuit
14 33 -- Optical head
31 -- Head drive circuit
32 -- Impedance-conversion circuit

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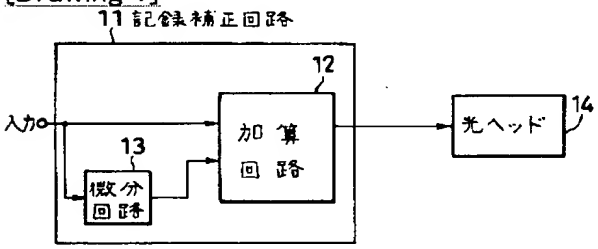
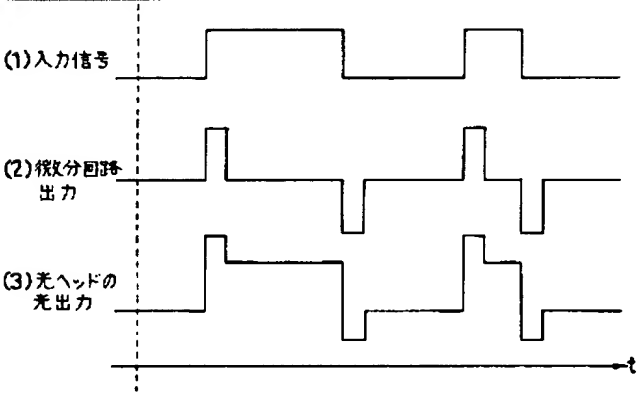
DRAWINGS

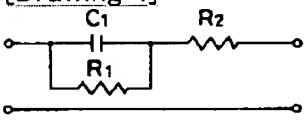
[Drawing 1]



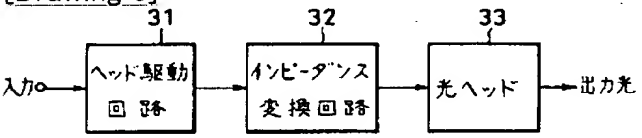
[Drawing 2]



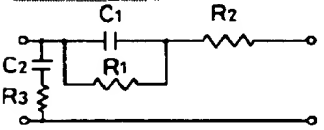
[Drawing 4]



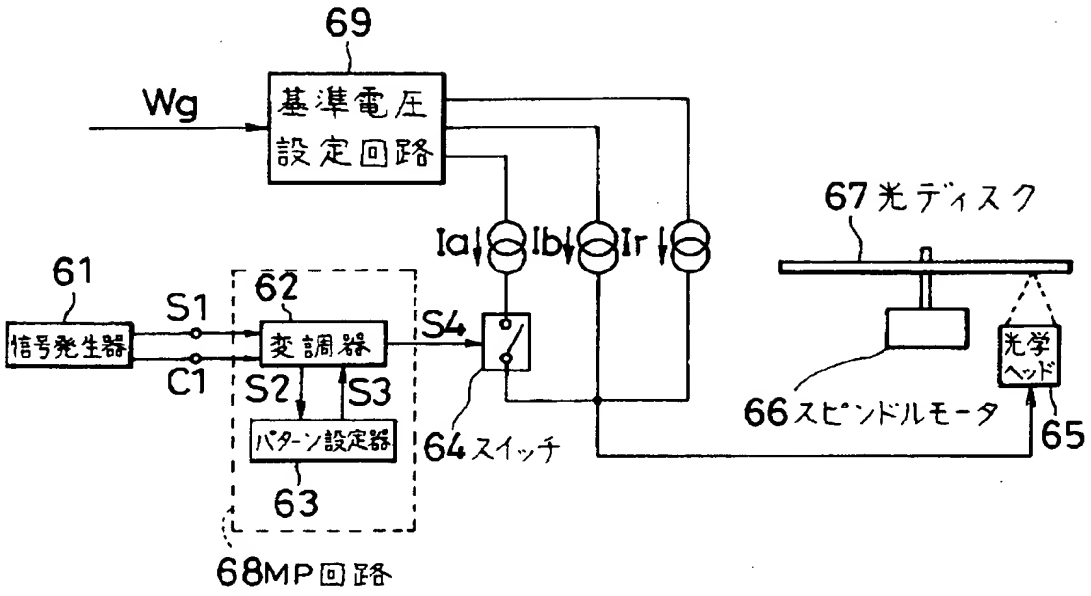
[Drawing 3]



[Drawing 5]



[Drawing 6]



[Translation done.]

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(43)公開日　平成６年(1994)３月29日

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	7/125		C 7247－5D		

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(22)出願日　平成４年(1992)９月９日

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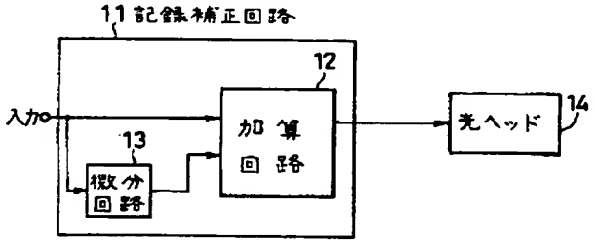
(54)【発明の名称】　記録補正回路

(57)【要約】
【目的】　光記録において、入力パタン毎に記録波形を変化させることなく、記録媒体の熱伝導特性や前後の記録マークの影響を受けない安定な光記録を行なえるようにする。
【構成】　入力信号を微分回路１３に入力して入力信号の変化量に相当する微分信号を得る。この微分信号と元の入力信号を加算回路１２に入力して加算し、その出力信号により、光ヘッド１４を駆動する。これにより、記録媒体の熱伝導特性を補正した記録を行い、前後の記録マークの影響を受けない安定な光記録を行って、入力パタン毎に記録波形を変える必要性をなくす。



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【特許請求の範囲】

【請求項１】　光ヘッドを用いて情報を記録する光記憶の記録補正回路において、

入力信号を入力とし該入力信号の変化量を求める第１の回路と、

前記入力信号と前記第１の回路の出力とを入力として加算する第２の回路とを有することを特徴とする記録補正回路。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、光ディスク等の光記録における記録回路に関し、詳しくは媒体の熱伝導特性に影響されないようにするため記録波形を補正する記録補正回路に関するものである。

【０００２】

【従来の技術】光ディスク等の光記録では、媒体の熱伝導特性に影響されて記録マークが歪んだりするため、記録波形の補正を行っている。この種の技術としては、特開平３－１８５６２８号に開示された記録方法および装置の例がある。図６にその従来例の構成を示す。図中、６１は信号発生器、６８はＭＰ（マルチパタン）回路、６２はＭＰ回路６８の変調器、６３はＭＰ回路６８のパタン発生器、６４はスイッチ、６５は光ヘッド、６６はスピンドルモータ、６７は光ディスク、６９は基準電圧設定回路を表している。

【０００３】まず、記録ゲート信号Ｗｇにより記録が指示されると、基準電圧設定回路６９において記録用電流Ｉａとバイアス電流Ｉｂが発生される。ここで、信号発生器６１から記録信号Ｓ１およびクロックＣ１（記録信号Ｓ１のクロックの整数倍の周波数信号）が入力されると、ＭＰ回路６８内の変調器６２とパタン発生器６３が動作し、その間で入力パタン信号Ｓ２と記録パタン信号Ｓ３のやりとりが行われて記録信号Ｓ１の入力パタン毎に適当なパタンの記録用のシリアル信号Ｓ４が発生される。この記録用のシリアル信号Ｓ４によりスイッチ６４が作動して記録用電流Ｉａが調整される。この記録用電流Ｉａはバイアス電流Ｉｂに重畳され、これらの電流で光ヘッド６５が駆動されて、光ヘッド６５から光ビームが発生し、光ディスク６７上に記録が行われる。なお、図中のＩｒは記録ゲート信号Ｗｇがなくなった時、即ち読み出し時に基準電圧設定回路６９で発生されて光ヘッド６５を駆動する読み出し用の電流である。

【０００４】

【発明が解決しようとする課題】しかしながら、上記従来例による記録方法では、入力パタン毎に記録波形を変える必要があり、入力パタンに対応する信号パタンを記録しておく必要があった。また、ＣＡＶ（一定角速度）及びＭＣＡＶで回転させる光ディスクでは内周，外周で速度及び記録パワーが異なるため、各光ディスクの半径位置毎に入力パタンに対応する信号パタンを記録しておく必要がある。そのため、パタン発生器６３に入力パタンに対応した多くの記録パタンを用意しておく必要があった。

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【０００５】また、変調器６２とパタン発生器６３とにおいて、入力パタン及び記録パタンのやりとりを行なうため、高速な信号処理ができないとう問題があった。

【０００６】本発明は、上記問題点を解決するためになされたものであり、その目的は、光記録において、入力パタンに対応する記録パタンを用いないで、媒体の熱伝導特性や前後の記録マークの影響を受けない安定な光記録を行なえる記録補正回路を提供することにある。

【０００７】

【課題を解決するための手段】上記の目的を達成するため、本発明では、光ヘッドを用いて情報を記録する光記憶の記録補正回路において、入力信号を入力とし該入力信号の変化量を求める第１の回路と、前記入力信号と前記第１の回路の出力とを入力として加算する第２の回路とを有する構成としている。

【０００８】

【作用】本発明の記録補正回路では、入力信号を基に入力信号を微分した信号等の入力信号の変化量を元の入力信号に加えて光ヘッドに対する出力信号とすることにより、記録媒体の熱伝導特性を補正した記録を行って、前後の記録マークの影響を受けない安定な光記録を行い、入力パタン毎に記録波形を変える必要性をなくしている。

【０００９】

【実施例】以下、本発明を実施例により詳細に説明する。

【００１０】まず、光ディスクの記録過程のモデルにより、本発明の原理を説明する。媒体は数層からなる記録層および上下の保護層，基板からなる。記録ビームスポットの光強度をＰ（ｔ）、記録ビームスポットがｘ方向に速度ｖで移動しているとする。このようにすると、媒体上の最高温度T_{max}（ｓ）は次式で近似できる。

【００１１】T_{max}（ｓ）＝Ｐ（ｓ）Ｇ（ｓ）

ここで、Ｐ（ｓ）は記録ビームスポットの光強度Ｐ（ｔ）のラプラス変換関数、Ｇ（ｓ）は光ディスクの記録過程の伝達関数である。伝達関数Ｇ（ｓ）の時間軸関数であるＧ（ｔ）は、次のように与えられる。

【００１２】

【数１】

$$G(t)=\frac{1}{C_1\delta_1+C_0h+C_2\delta_2}\cdot\frac{\exp\left[-\frac{vt^2}{A_0^2+4\tau'}\right]}{\pi(A_0^2+4\tau')}$$

【0013】ここで、

【0014】

【数2】

$$\delta_1=\sqrt{\pi D_1(t+t_c)},\quad \delta_2=\sqrt{\pi D_2(t+t_c)},$$

$$\tau'=\int_0^t D(t')\,t'=D_{eff}t,$$

【0015】t_cは定数である。また、

$D(t)=(\lambda_1\delta_1+\lambda_0 h+\lambda_2\delta_2)/(C_1\delta_1+C_0 h+C_2\delta_2)$

であり、また、$\lambda_1=C_1D_1$，$\lambda_0=C_0D_0$，$\lambda_2=C_2D_2$である。

【0016】上記関数を基に近似計算を行なうと、伝達関数G（s）は次のように導出される。

【0017】

$$G(s)=b/(s+a)\qquad(2)$$

ここで、

【0018】

【数3】

$$a=\frac{1}{2}\frac{(C_1\sqrt{\pi D_1}+C_2\sqrt{\pi D_2})^2}{(C_0h)^2}+\frac{4D_0}{A_e^2}+\frac{v^2}{4D_e},\quad b=\frac{1}{C_0h\pi A_0^2},$$

$$A_e^2=A_0^2+4D_{eff}t_0,$$

$$D_e=\frac{A_0^2}{4t_0}+D_{eff}$$

【0019】となる。ただし、記録層，基板，保護層の熱容量をC_0，C_1，C_2、拡散係数をD_0，D_1，D_2、記録層の膜厚をh、媒体の面内方向の実効拡散係数をD_{eff}、記録ビームスポットの半径をA_0、特性時間をt_0で表す。

【0020】従って、式（2）の伝達関数G（s）を用いて記録過程が表されるので、媒体温度を記録マーク形成部で均質に、マークエッジ部で急峻にするためには、入力側に次式の伝達関数$G(s)^{-1}$で表される補正を行なえばよい。

【0021】

$$G(s)^{-1}=(s+a)/b\qquad(3)$$

ここで、微分定数をαとし微分回路出力の定数をβとすると、上記式（3）は次のように表せる。

【0022】

$$G(s)^{-1}\propto\beta\cdot s/(s+\alpha)+1\qquad(4)$$

即ち、以下の実施例に示すように、記録等化において入力信号を微分したものを入力信号に加えることにより、媒体上の温度分布が均質化され、良好な記録マークが形成できることになる。

【0023】以下、図面を用いて本発明の実施例を詳細に説明する。

【0024】〔第1の実施例〕図1は本発明の第1の実施例を示すブロック図である。図中、11は記録補正回路、12は記録補正回路11内の加算回路、13は記録補正回路11内の微分回路、14は光ヘッドを表す。入力は加算回路12の一方の入力側と微分回路13の入力側に接続され、微分回路13の出力は加算回路12のもう一方の入力側に接続され、加算回路12の出力が光ヘッド14への出力信号とされている。

【0025】以下、上記構成の実施例の動作および作用を図2の波形図を用いて説明する。

【0026】まず、図1の記録補正回路11の入力に図2の（1）で示される入力信号が入ると、入力信号の変化量を求める一例である微分回路13において入力信号の微分信号が得られる。なお、ここでは、微分回路13において、入力信号を遅延させた信号を入力信号から引くことによって微分信号を得る例を図2の（2）に示す。

【0027】このようにすると、加算回路12に図2の（1）で示された入力信号と図2の（2）で示された微分回路13出力が入力される。加算回路12は、この二つの信号に各々に重みを付けて加算し、その加算した出力信号により光ヘッド14を駆動する。その結果、光ヘッド14から図2の（3）に示す光出力が得られる。このような光出力で媒体上に記録を行なうと、前述の原理に示したとおり媒体の熱伝導特性を補正してマークを記録することができ、媒体上に安定な記録マークが形成できる。また、媒体上にマークを記録する時に、前後の記録マークの影響を受けなくできるので、記録パタン毎に記録波形を変える必要がない。なお、加算回路12の入力に入力信号と微分回路13出力との位相差を合せる遅延回路を入れておくことも有効である。

【0028】上記実施例では遅延差動により微分を行なう例を示したが、微分回路は通常の抵抗と容量を組み合わせた微分回路や、インダクタンスと容量を組み合わせ

た微分回路等でも良いことは言うまでもない。

【００２９】また、光ディスクの内周，外周において速度が異なった場合においても、前述した式（３）あるいは式（４）にしたがって補正してやればよく、従来のように余計に記録パタンを記録しておく必要はない。

【００３０】なお、加算回路１２における入力信号と微分回路１３出力との重み付けは、入力信号を１にした時に微分回路１３出力の重み付け係数をゼロ以上１０／ａ以下としてもよい。この場合、微分回路１３出力の重み付け係数を０．５／ａ以上２／ａ以下とするのが好例である。

【００３１】〔第２の実施例〕図３は本発明の第２の実施例を示すブロック図である。第１の実施例がヘッド駆動回路である加算回路の前で記録補正を行なったものであるのに対し、本実施例では、ヘッド駆動回路３１と光ヘッド３３の中間にインピーダンス変換回路３２を設けて実現している。本実施例は、光ヘッド３３の入力インピーダンスが抵抗で近似できる性質を利用している。本実施例の基本的動作は第１の実施例と同様である。

【００３２】インピーダンス変換回路３２の具体的一例を図４に示す。また、電流の立ち上がり補正回路を加えた変形例を図５に示す。図中、C_1，C_2はコンデンサ、R_1，R_2，R_3は抵抗である。これらの回路例では、抵抗R_1，R_2を直列に図３の光ヘッド３３に接続し、このうち一方の抵抗R_1に並列にコンデンサC_1を接続している。定常時の信号電流は抵抗R_1，R_2を通して流れるが、ヘッド駆動回路３１からの信号の変化時にはコンデンサC_1，抵抗R_2の微分回路からの変化量に相当する微分電流が抵抗R_2で加算されて流れる。また、図５の回路では、上記回路に加えて、図３のヘッド駆動回路３１の出力に並列に、コンデンサC_2と抵抗R_3の直列回路を電流の立ち上がり補正回路として接続している。このコンデンサC_2，抵抗R_2の回路は、積分作用によって駆動

電流の立ち上がりを補正している。

【００３３】なお、上記した第２の実施例による波形は、曲線状になるので、パルストレインを行なって、その振幅の外縁部の形を図２の（３）のようにしてもよい。

【００３４】

【発明の効果】以上の説明で明らかなように、本発明の記録補正回路による光出力で媒体上に記録を行なうと、媒体上に媒体の熱伝導特性を補正してマークを記録することができ、安定な記録マークが形成できる。また、媒体上にマークを記録する時に、前後の記録マークの影響を受けなくなるので、入力パタン毎に記録波形を変える必要がない。さらに、光ディスク等のように内周，外周において速度が異なった場合においても、周位置に合わせて記録パタンを記憶しておく必要はない。また、入力パタンにより記録パタンを参照して記録波形の変形を行う必要がないので、高速な記録が実現できる。

【図面の簡単な説明】

【図１】本発明の第１の実施例を示すブロック図

【図２】上記第１の実施例の動作を説明する波形図

【図３】本発明の第２の実施例を示すブロック図

【図４】上記第２の実施例のインピーダンス変換回路の具体例を示す回路図

【図５】同じく上記第２の実施例のインピーダンス変換回路の具体例の変形例を示す回路図

【図６】従来例を説明する構成図

【符号の説明】

１１…記録補正回路

１２…加算回路

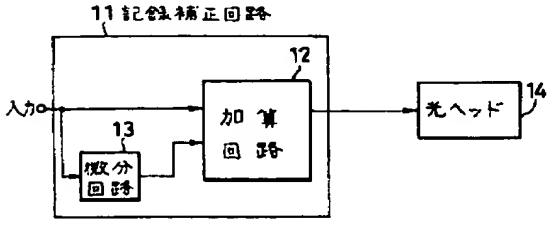
１３…微分回路

１４，３３…光ヘッド

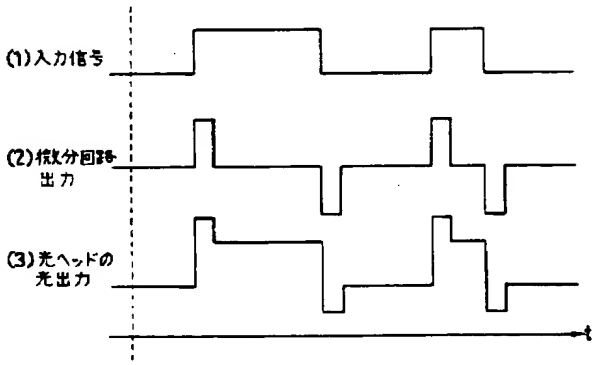
３１…ヘッド駆動回路

３２…インピーダンス変換回路

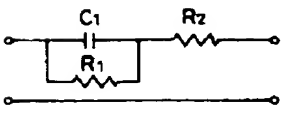
【図１】



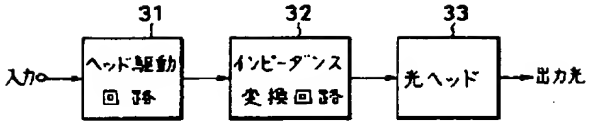
【図２】



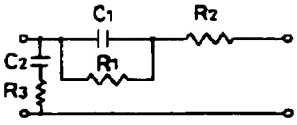
【図４】



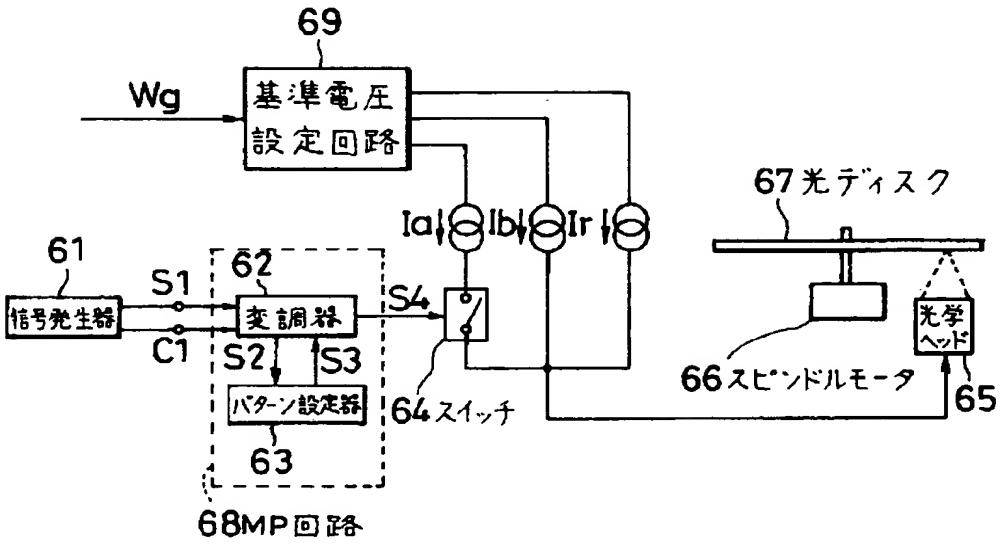
【図３】


31
32
33
入力
ヘッド駆動回路
インピーダンス変換回路
光ヘッド
出力光

【図５】


C1
R2
C2
R1
R3

【図６】


69
Wg
基準電圧設定回路
Ia
Ib
Ir
67光ディスク
61
S1
62
信号発生器
変調器
S4
C1
S2
S3
パターン設定器
64スイッチ
光学ヘッド
66スピンドルモータ
65
63
68MP回路